MTF Team Comments on the "Consensus technical summary of the members of the review panel for Proof-of-Principle Proposals in Fusion Energy Science, June 8-11, 1998"

The Magnetized Target Fusion (MTF) team is delighted with the panel evaluation of the proposed MTF program. The judgement by this diverse and distinguished panel that MTF is "qualified for Proof-of-Principle status" is highly significant in our view, because we realize that the MTF approach to fusion is unfamiliar to most researchers in the fusion community. We certainly concur with the observation that MTF is "an innovative proposal that represents a true alternative to existing magnetic and inertial fusion concepts." The MTF team sincerely thanks and greatly appreciates the review panel for its intense work.

The technical comments on our specific idea to use the Field Reversed Configuration (FRC) as the plasma target impressed us as being thorough, accurate, and fair. We accept the recommendation to pursue a "2D MHD and transport simulation, including adiabatic and ohmic heating, particle and energy transport losses, and eddy current heating at the liner during implosion." In fact, we assumed that development of such models was a high priority for the MTF program. We define success as achieving agreement between computer model results and experiments in the Proof-of-Principle campaign. Such agreement would pave the way for proceeding to Proof-of-Performance in an additional 2 years if the 3-year Proof-of-Principle program is successful. We note one discrepancy from our proposal in the panel's text: the MTF goal of "D-T equivalent $Q \sim 0.1$" is the upper end of the range we predict using simple zero-dimensional modeling. In the proposal we argue that Q between 1% and 10% with understanding based on agreement between experiments and computer modeling provides the criteria for success at this Proof-of-Principle stage of development.

On reactor issues, we respectfully disagree with the majority of the panel who "think it is unlikely that this concept will ultimately result in commercial fusion energy production." In our view, a more appropriate position is one of suspended judgement. The MTF idea of using pulsed energy to heat a small-size magnetized plasma has simply received inadequate study to judge whether it makes an attractive commercial system. That the idea can be explored scientifically at very low cost, even at the level of burning plasma performance, is a major attraction to MTF, which may eventually open a pathway to low-cost fusion development all the way to commercialization. The fact that new facilities are not required to begin research because of Defense Program investments in liner technology is serendipitous to say the least.

Furthermore, the pulsed nature of MTF, as with ICF, allows an advantage in development. Scientific feasibility and all the key questions like energy gain per pulse can be studied on a single-shot basis, and the relatively expensive development of technology needed for energy application can be postponed until after scientific feasibility is demonstrated. Liner technology should be viewed as an expeditious means for doing MTF research, analogous to the use of glass lasers in ICF, and not necessarily the ultimate method by which plasma will be compressed. As noted by the panel, "MTF plasma resides in between in the vast parameter space spanned by magnetic fusion and inertial fusion." In addition to the Field Reversed Configuration discussed in the proposal, many other target configurations are possible. The proposed $6.6 million per year MTF research program includes $600K per year of funding for exploratory experiments. The Proof-of-Principle program will establish a core set of diagnostics and operating personnel, so that exploratory ideas from many institutions can be tested at low cost on existing pulsed-power facilities at the Air Force Research Laboratory, Los Alamos, Sandia, and elsewhere.

Like ICF, there are many issues of repetition rate, safety, materials, waste management, and ultimately cost that eventually will need to be addressed. Unlike ICF, the power requirements and precision of implosion are considerably reduced, which may open more possibilities than represented by conventional ICF. Possibilities for practical energy range from stand-off delivery of power, as discussed by D. Ryutov at the 1998 Princeton Innovative Confinement Concept Workshop, to unique reactor visions, like that of B.G. Logan in which the first wall and blanket are vaporized and turned into a working fluid for an efficient MHD generator. It is with these embryonic ideas in mind that we argue for a suspension of judgement on commercial feasibility. These ideas need evaluation, as well as new ones likely to emerge as MTF is developed. Consistent with this view, the proposed program includes a small multi-institutional team led by Westinghouse to do scoping studies on the reactor potential.